

Moving More Cars Through the Same Space Using Unconventional Intersection Designs

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Objective

- Study the “menu” of unconventional intersection designs, and
- Learn the important advantages and disadvantages of each design so that you can
- Specify an appropriate unconventional intersection design for a particular problem location

Problem

- Growing demand
- Close to 50/50 directional split
- Conventional solutions exhausted
- Too expensive to widen
- Structures expensive and unpopular
- ITS, transit, demand management, etc. not helpful

Potential Solution: Unconventional Designs

- 12 designs on current intersection “menu”
- All 12 designs published
- Most of the 12 designs in use in U.S.
- This presentation discusses 8 of 12 with most potential in NC

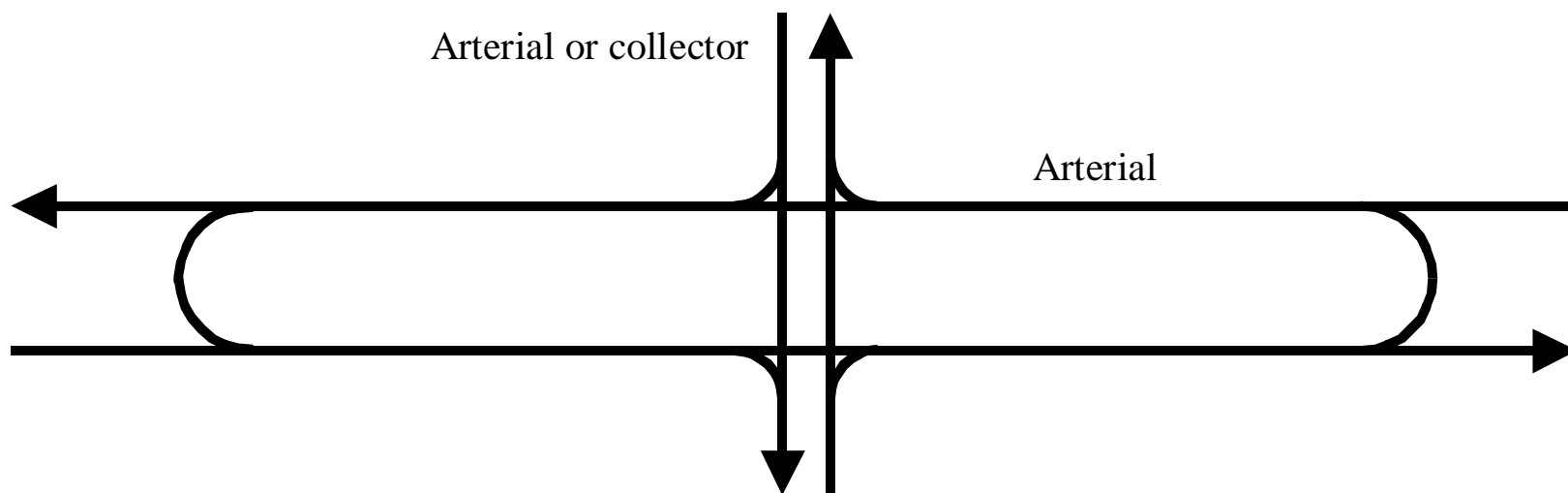
Major Principles

- Reduce delay to through vehicles
- Reduce number of conflict points at intersections
 - Separate remaining conflict points
 - Reduce signal phases
- Accomplished mostly by rerouting left turns

Driver Confusion?

- Potential is there; however...
- Most in place somewhere for years
- Precedent in other new designs
 - Roundabout, single point diamond, etc.
- Traffic control devices helpful
- Design whole corridor

Median U-Turn



Median U-Turn Advantages

- Increased capacity
- Reduced travel time
- Enhanced progression
- Fewer threats to pedestrians
- Fewer conflict points
- Lower collision rates

Median U-Turn Capacity

		Critical V/C, 30,000 ADT	
Minor ADT	% turns	Med. U-turn	Conventional
15,000	20	0.74	0.86
	40	0.88	0.90
25,000	20	0.90	1.04
	40	1.11	1.14

Typical Corridor Travel Time

MOE	TWLTL	Median U-Turn	
Travel time, veh-hours	403	280	
Stops per vehicle	2.08	2.19	

Median U-Turn Collision Rates (per 100 mil. veh-miles)

Signalized?	TWLTL	Conventional	Median U-Turn
Yes	1220	750	600
No	460	180	220

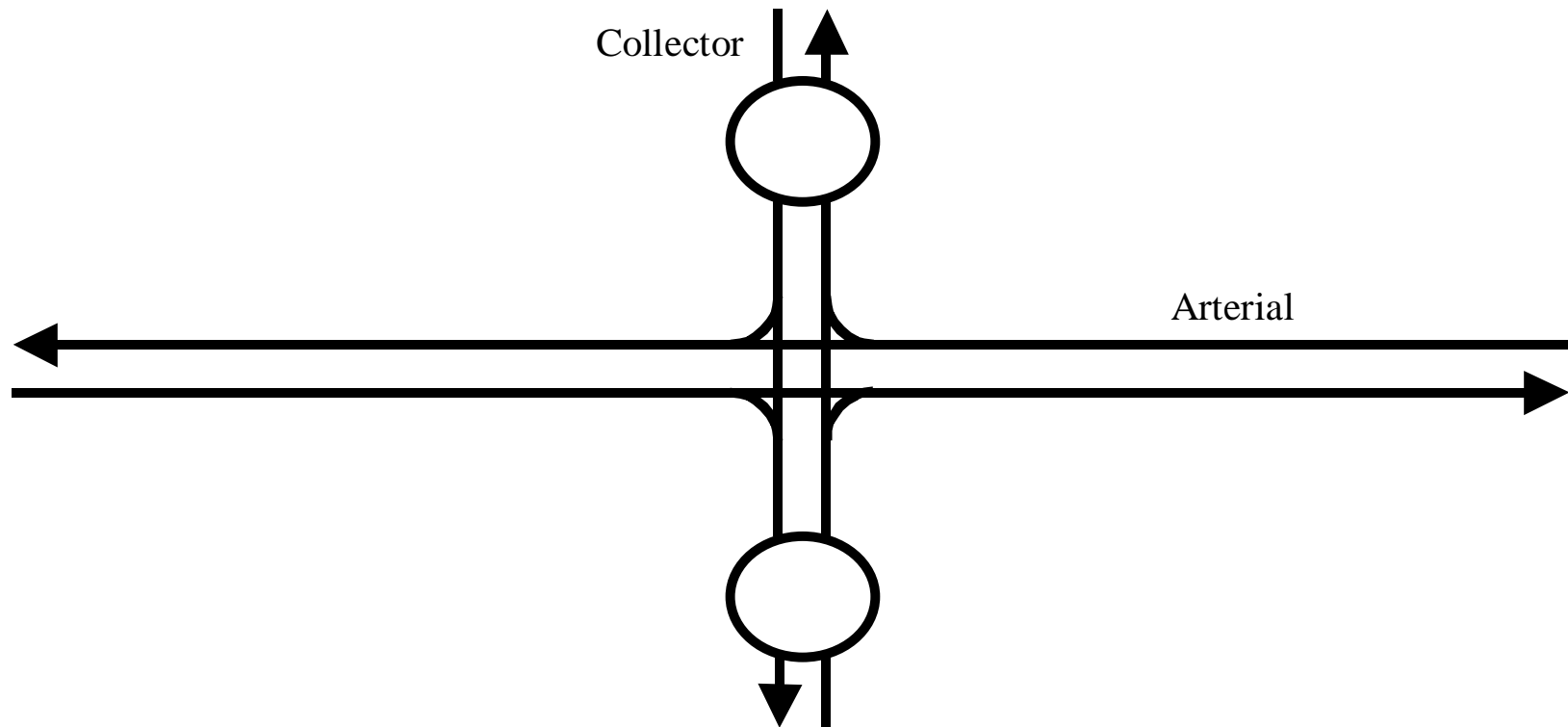
Median U-Turn Disadvantages

- Left turn delay
- Left turn travel distance
- Left turn stops
- Wider right-of-way
- Higher minimum green time for pedestrians
- Indirect left turns into businesses
- Wide median means less business visibility

Median U-Turn Variations

- Three-legged intersection--very efficient
- Narrow median with turning bulbs
- U-turns on minor street
- STOP sign for u-turns
- Interchange

Bowtie



Bowtie Advantages

- Narrow major street right-of-way
- Short, simple pedestrian crossing
- Enhanced major street progression
- Aesthetics
- Developments can tie into roundabouts

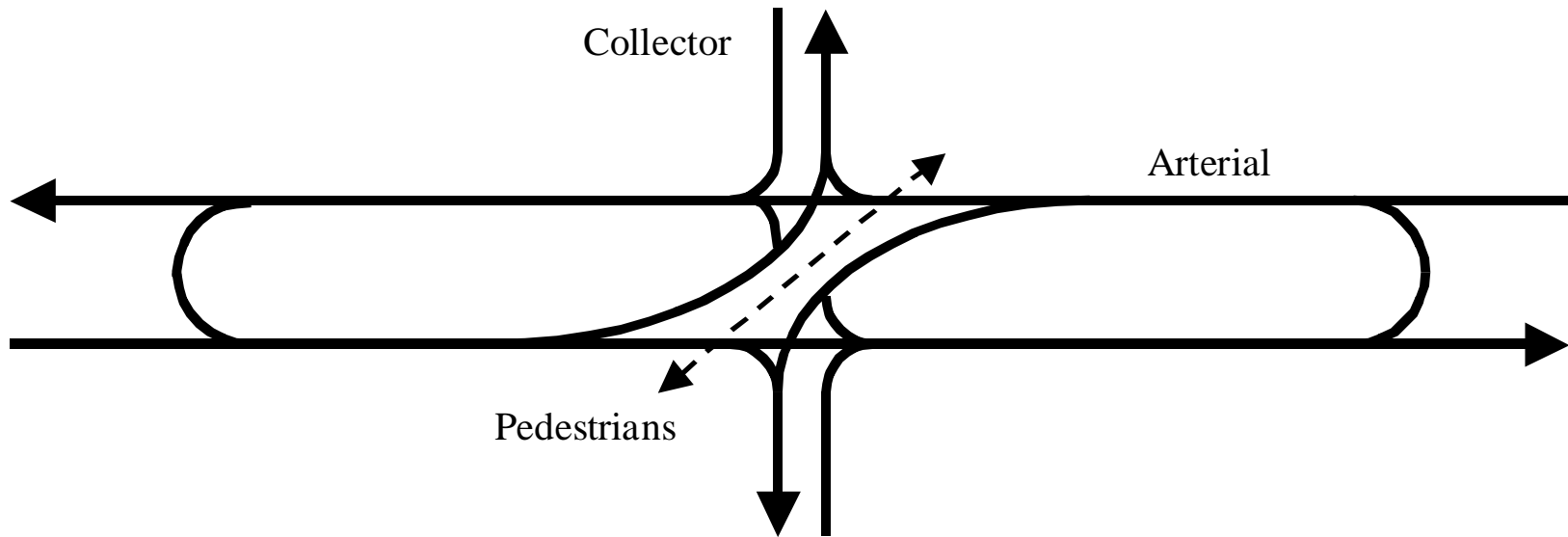
Bowtie Disadvantages

- Low minor street capacity
- Left turn delay
- Left turn travel distance
- Left turn stops
- Difficult arterial u-turn

Bowtie Variation— Raindrop Interchange

- Roundabouts instead of signals at ramp terminals
- Many in use around U.S. now
- Safe
- Efficient
- Narrow bridge

Superstreet



Superstreet Advantages

- Perfect two-way progression with any signal spacing!
- More efficient with light minor street volumes
- Should be safer
- All pedestrian crossing controlled
- Works well on an arterial lined with development

Superstreet Travel Time

MOE	TWLT	Median U-Turn	Superstreet
Travel time, veh-hours	403	280	314
Stops per vehicle	2.08	2.19	2.59

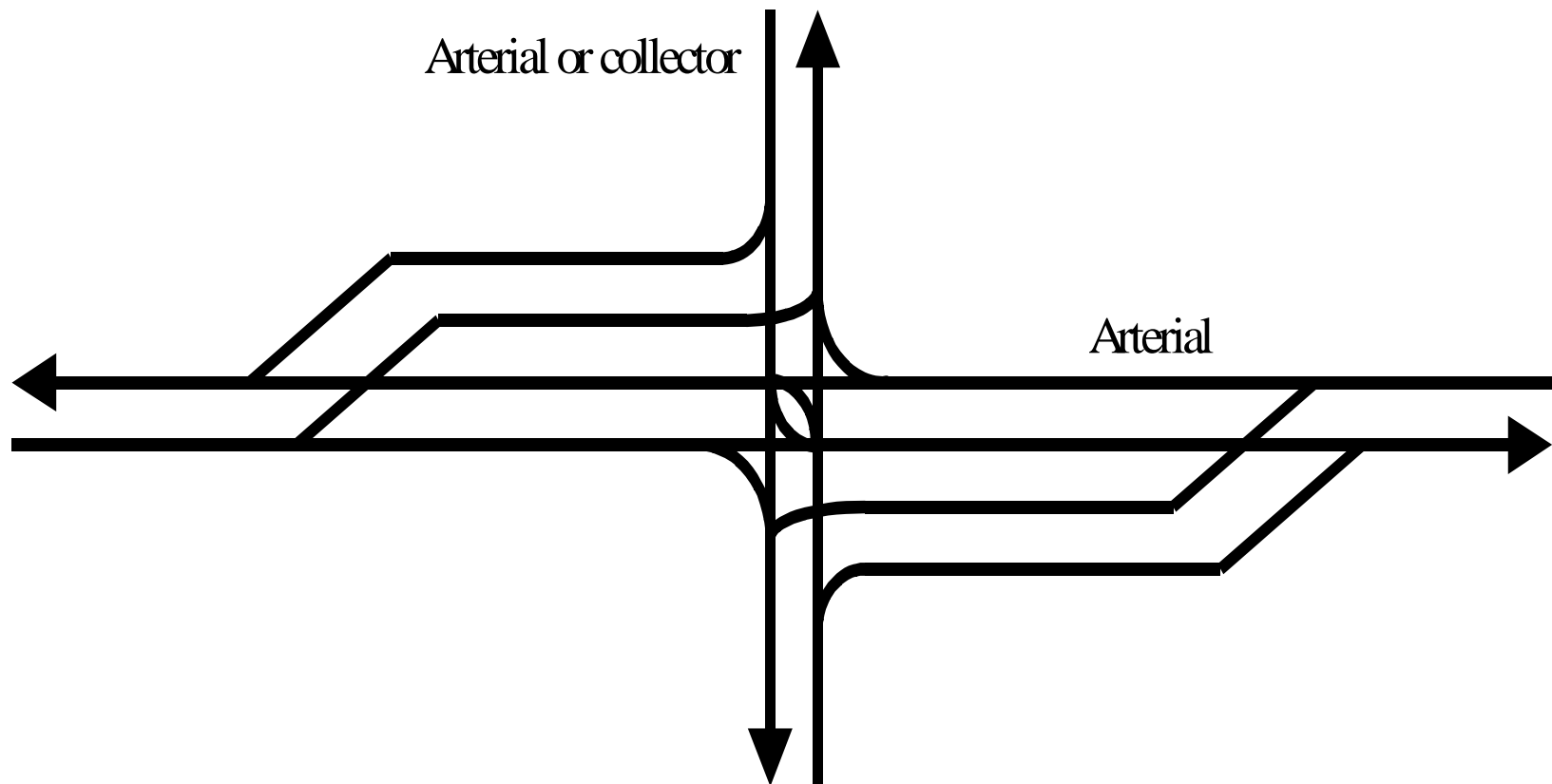
Superstreet Disadvantages

- Less efficient with heavy minor street volumes
- Wider right-of-way
- Two stage pedestrian crossing
- Indirect left turns into businesses
- Wide median means less business visibility

Superstreet Variations

- Three-legged intersection
- One direct left turn
- No direct left turns
- One conventional intersection in corridor

Continuous Flow Intersection



Continuous Flow Intersection

Advantages

- Reduced travel time with high volumes
- Keeps traffic moving
- Enhanced progression
- Narrower major street ROW
- Fewer conflict points

Continuous Flow Intersection

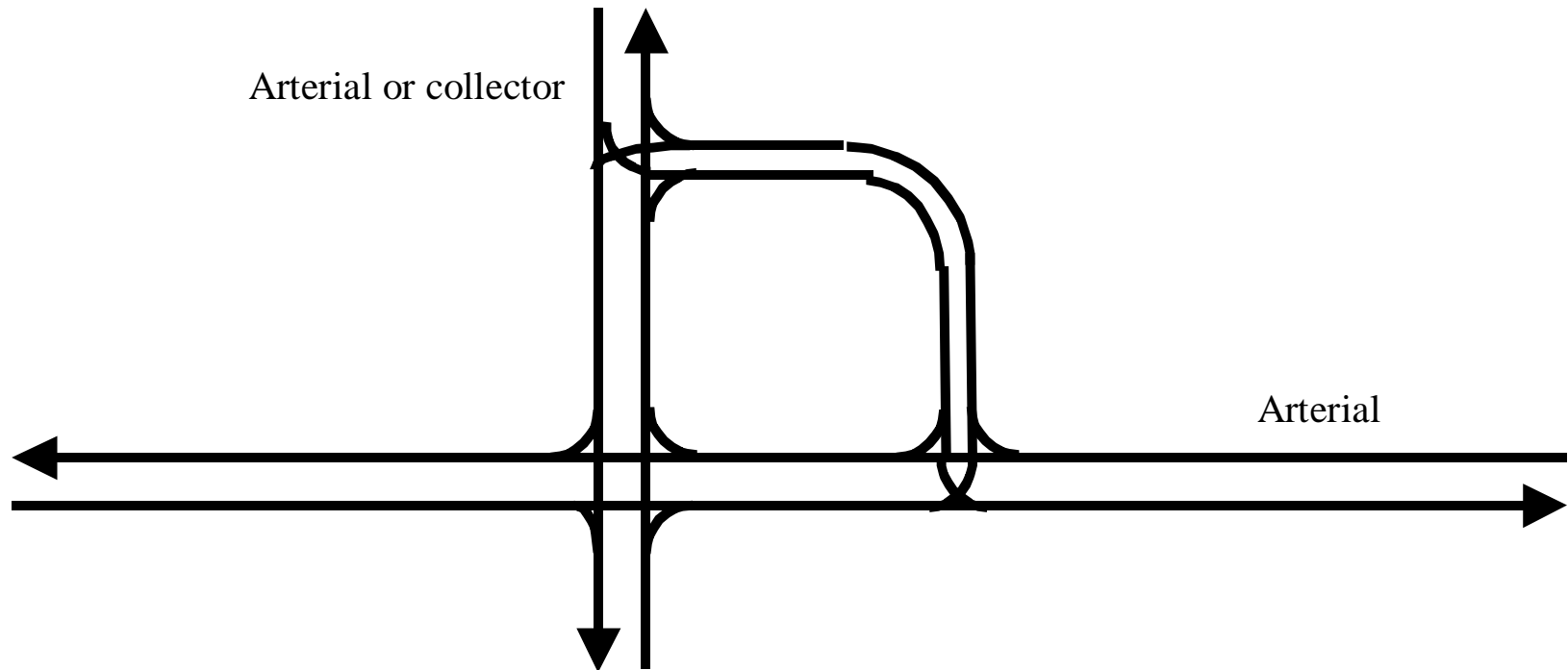
Disadvantages

- No u-turns at intersection
- Pedestrians must cross ramps
- Access difficult for parcels next to ramps

Continuous Flow Intersection Variations

- Three-legged intersection
- Ramps on one to four legs
- Continuous Flow Interchange

Single Quadrant



Single Quadrant Advantages

- Typically vies with median u-turn as most efficient unconventional design
- Major and minor streets can have narrow rights-of-way
- Connector road provides development opportunity
- Some pedestrians have shorter, simpler crossing

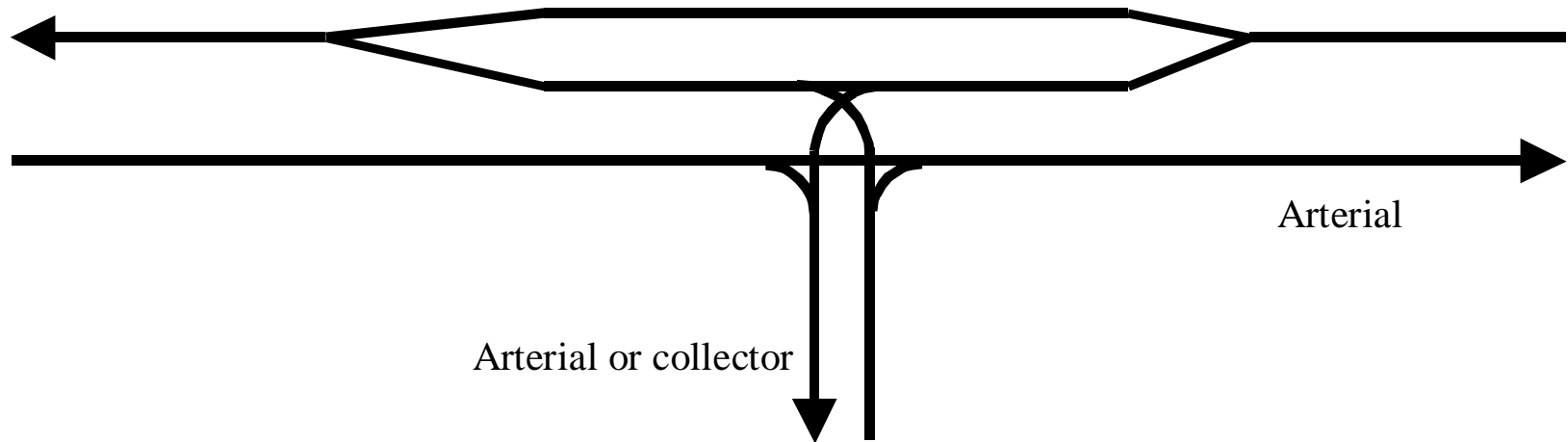
Single Quadrant Disadvantages

- Some left turns have more travel time, distance, stops
- ROW for connector road
- No u-turns at main intersection
- No driveways opposite ends of connector road
- Some pedestrians must cross connector road too

Single Quadrant Variations

- Which quadrant?
- Two quadrants
- Allow a direct left turn or two
- Single quadrant interchange

Continuous Green T



Continuous Green T Advantages

- Lower travel times
- Narrow ROW

Continuous Green T

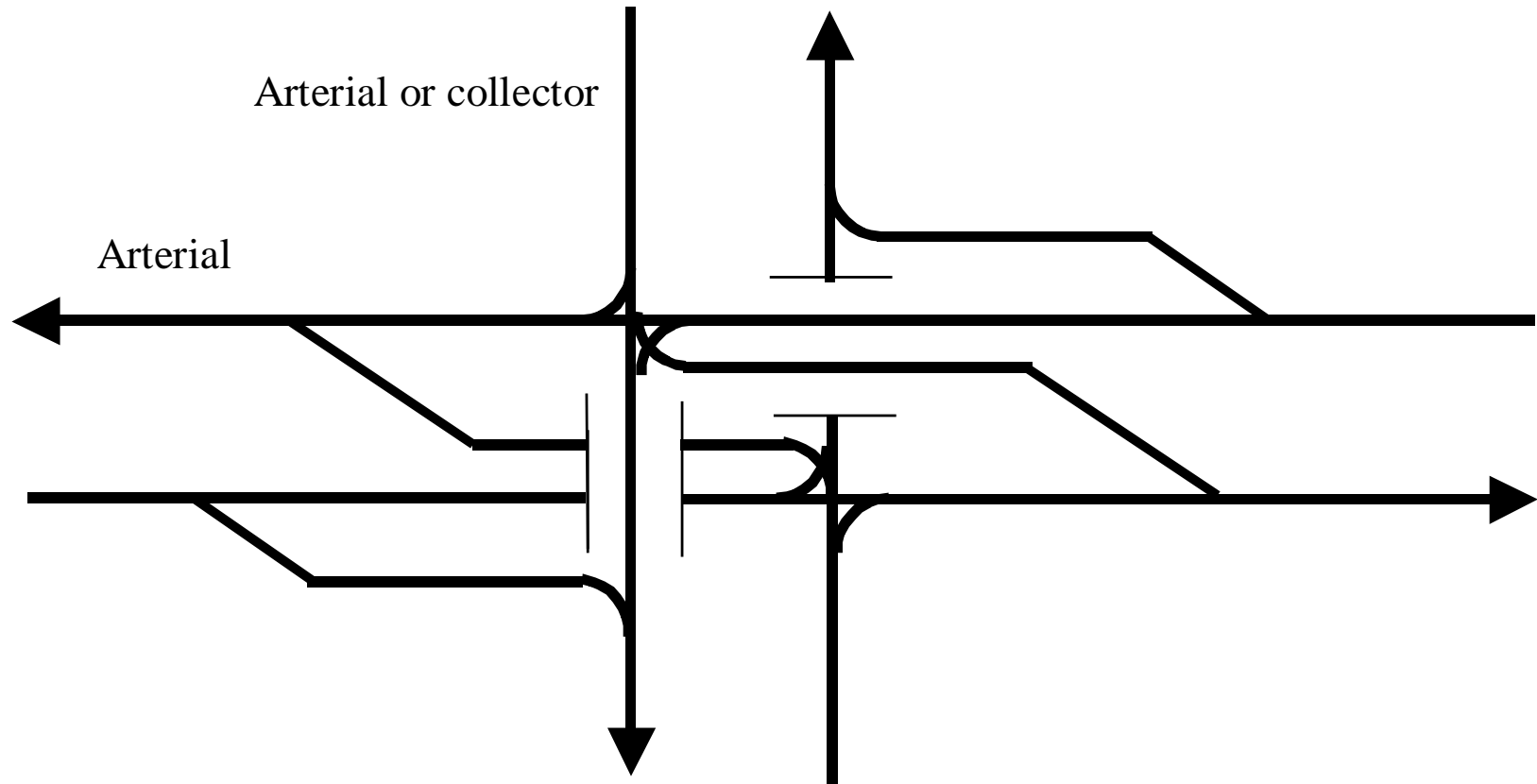
Disadvantages

- Median design difficult
- Right-in-right-out driveways only on top of the T

Continuous Green T Variation from Florida

- No median
- On top of T, left lane signalized while right lane has 100% green
- Left lane signal shows red to allow left turns from stem of T
- Lane changing and enforcement issues?

Echelon Interchange



Echelon Interchange Advantages

- Much higher capacity than at-grade intersections
- Much lower travel time than at-grade intersections
- Enhanced progression for both streets
- Meters traffic to help downstream signals

Typical critical volume/capacity ratios

Intersection volume, veh/day	Median u-turn	Echelon interchange	
60,000	0.89	0.75	
70,000	1.03	0.86	
80,000	1.19	0.99	

Typical simulated peak hour total travel times, hours

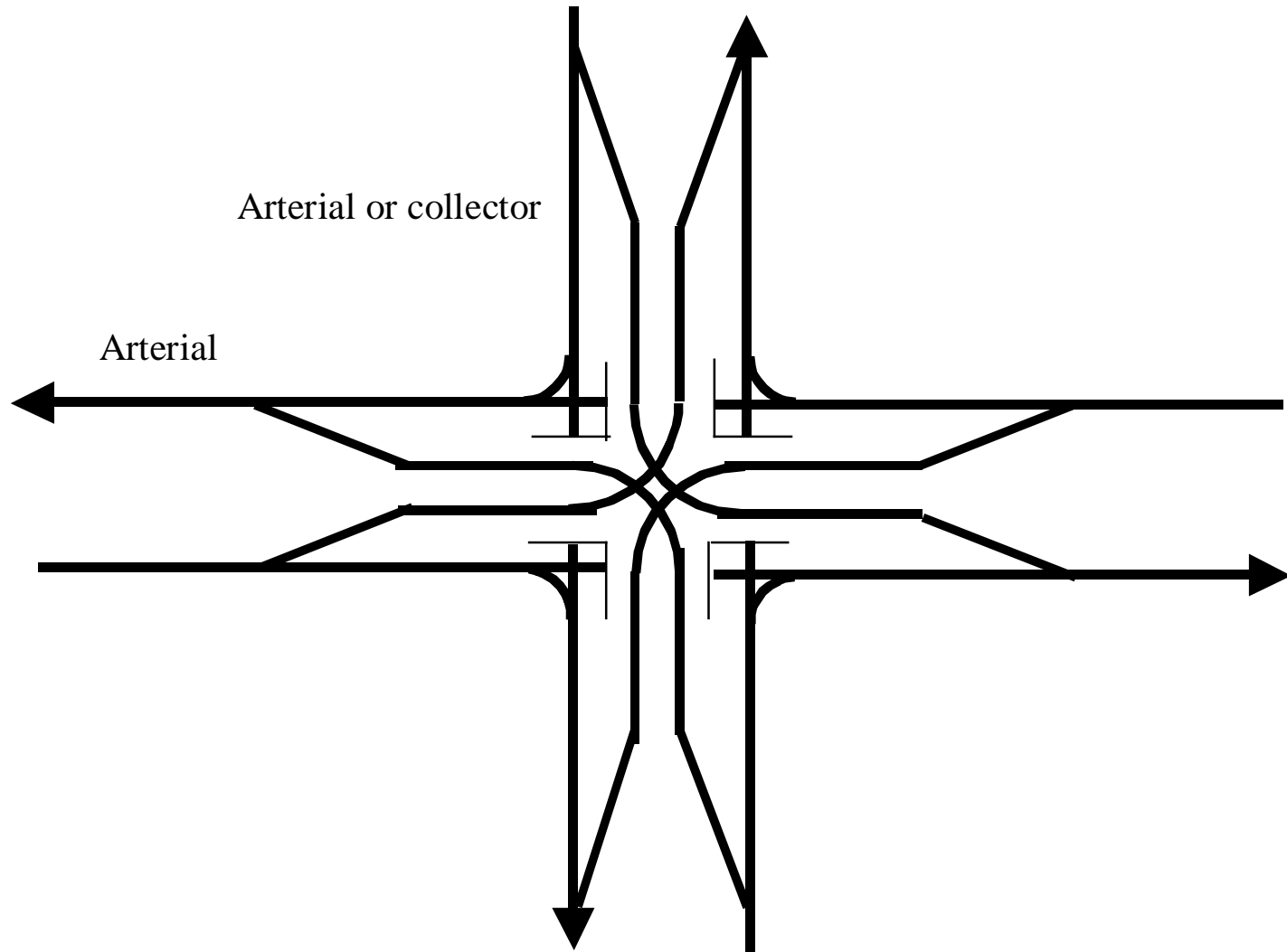
Intersection volume, veh/day	Median u-turn	Echelon interchange	
60,000	75	60	
70,000	140	75	
80,000	170	105	

Echelon Interchange

Disadvantages

- High structure cost
- Access impaired to 3 quadrants
- No u-turns at or near interchange
- Pedestrians must climb grades or cross streets unprotected by signals

Center Turn Overpass



Center Turn Overpass

Advantages

- Much higher capacity than at-grade intersections
- Much lower travel time than at-grade intersections
- Enhanced progression for both streets
- Meters traffic to help downstream signals
- Direct pedestrian crossing
- Access to roadside businesses similar to conventional intersection with medians

Typical critical volume/capacity ratios

Intersection volume, veh/day	Median u-turn	Echelon interchange	Center turn overpass
60,000	0.89	0.75	0.80
70,000	1.03	0.86	0.93
80,000	1.19	0.99	1.06

Typical simulated peak hour total travel times, hours

Intersection volume, veh/day	Median u-turn	Echelon interchange	Center turn overpass
60,000	75	60	55
70,000	140	75	75
80,000	170	105	125

Center Turn Overpass

Disadvantages

- High structure cost
- Difficult to design if streets are not perpendicular
- Visibility to businesses blocked by structure
- Cost to obtain rights to design

A Review of the Menu

- Median u-turn
- Bowtie
- Superstreet
- Continuous flow intersection
- Single quadrant
- Continuous green T
- Echelon
- Center turn overpass
- Plus 4 others

Which unconventional alternative makes sense where...

- An undivided four-lane arterial meets a two-lane collector in a dense urban area?

Which unconventional alternative makes sense where...

- A divided arterial serves many turns into and out of driveways and side streets but very low through crossing movements?

Which unconventional alternative makes sense where...

- Two huge arterials meet, there is dense development in all four quadrants, and pedestrian volumes are high?